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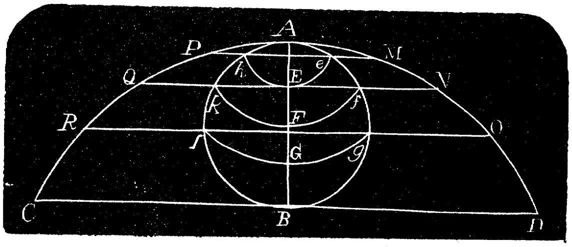
I. Solution by ALFRED HUME, C. E., Professor of Mathematics, University of Mississippi; H. W. DRAUGHON, Clinton, Louisiana; and the Proposer.



Let CAD be the cycloid, AB the diameter of generating circle. Divide AB into four equal parts at E, F, G, and with A as a center and radii equal to AE, AF, AG, draw arcs cutting the circle at e, h; f, k; g, l. Through e, h; f, k; g, l draw parallels to CD. Then, arc $AM=2$ chord $Ae=2AE$,

arc $AN=2$ chord $Af=2AF=4AE$,

arc $AO=2AG$, arc $AD=2AB$.

$\therefore AN=2AM,\ AO=3AM,\ AD=4AM.$

$\therefore AM=MN=NO=OD=AP=PQ=QR=RC.$

II. Solution by WILLIAM SYMMONDS, A. M., Professor of Mathematics and Astronomy, Pacific College, Santa Rosa, California.

Suppose the curve to be divided into n equal parts, n being any integral number. Through the points of division, which are points symmetrical with respect to the axis, let right lines be drawn. Call the distances severally from the points where these lines intersect the axis to the vertex equal to x.

Let $2r$ = height of the cycloid; then $8r$ = the entire length of the curve. If n be odd, $\sqrt{8rx}=\frac{1}{2n}\cdot 8r,\ \frac{3}{2n}.8r,\ \frac{5}{2n}.8r$, etc.

Whence respectively,

$$(1)\ x=\left(\frac{1}{2n}\right)^2\cdot 8r,\ \left(\frac{3}{2n}\right)^2\cdot 8r,\ \left(\frac{5}{2n}\right)^2.8r\ldots\ldots\left(\frac{n-2}{2n}\right)^2.8r=\left(\frac{1}{n}\right)^2 2r,\ \left(\frac{3}{n}\right)^2 2r,\left(\frac{5}{n}\right)^2 2r\cdots\cdots\left(\frac{n-2}{2n}\right)^2 2r.$$

If n be even, $\sqrt{8rx}=\frac{0}{n},\ \frac{8r}{n},\ \frac{16r}{n},\ \frac{24r}{n}$, etc.

$$\therefore\ (2), x=\left(\frac{0}{n}\right)^2 8r,\ \left(\frac{1}{n}\right)^2 8r,\ \left(\frac{2}{n}\right)^2 8r,\ \left(\frac{3}{n}\right)^2 8r, \text{ etc.}$$

Making $n=8$, in (2), we have, $x=0,\ \frac{r}{8},\ \frac{r}{2},\ \frac{9}{8}r$. If these distances be measured down the axis from the vertex, the ordinates to the points so determined will mark the curve in the points of division required.

Also solved by *P. H. Philbrick*, *H. C. Whitaker*, *C. E. Myers*, and *J. H. Beach*.

2. Proposed by SYLVESTER ROBINS, North Branch Depot, New Jersey.

Give the diminsions of thirteen rational trapezoids each one having 1885 for its parallel bisector; and as many more wherein each bisector is 1105.

Solution by A. H. BELL, Hillsboro, Illinois.

The bisector 1885 of the trapezoid, also the bisector 1105, given in the problem, are composed of the product of three prime numbers, of the form of

$4m+1$. All bisectors thus formed, will be the bisectors for 13 trapezoids.

No.	List for 1885, giving the parallel sides.	No.	List for 1105.
1.	65—1885—2665.	1.	73—1105—1561.
2.	377—1885—2639.	2.	155—1105—1555.
3.	593—1885—2599.	3.	221—1105—1547.
4	667—1885—2581.	4.	367—1105—1519.
5.	719—1885—2567.	5.	391—1105—1513
6.	965—1885—2485.	6.	455—1105—1495.
7.	1015—1885—2465.	7.	533—1105—1469.
8.	1085—1885—2385.	8.	595—1105—1445.
9.	1297—1885—2329.	9.	799—1105—1343.
10.	1363—1885—2291.	10.	809—1105—1337.
11.	1409—1885—2263.	11.	923—1105—1261.
12.	1537—1885—2171.	12.	995—1105—1205.
13.	1651—1885—2093.	13.	1057—1105—1151.

Observe that had the conditions, included "prime" then the four trapezoids only answering for 1885, are Nos. 3, 5, 9, and 11. For 1105, Nos. 1, 4, 10, and 13, as given above.

Solved under a slightly different conception by *G. B. M. Zerr*, and exhaustively discussed by Hon. *Josiah H. Drummond*, of Portland, Maine, in a paper which we expect to give later.

3. Proposed by J. A. CALDERHEAD, B. Sc., Superintendent of Schools, Limaville, Ohio.

Given the simultaneous angular velocities of a body about the principal axes through its center of of inertia, find the position of these axes in space at any assigned instant.

I. Solution by the Proposer.

Represent the axes, at first by α, β, γ; and if q be the quaternion defined in § 372 (*Tait's Quaternions*), and ω_1, ω_2, ω_3 (functions of the time) represent the angular velocities about the three axes in their new positions, we have obviously

$$2\,Vqq^{-1}=(e=)q(\omega_1\alpha+\omega_2\beta+\omega_3\gamma)q_{-1}.$$

Integrating this gives q, and the axes are then $q\alpha q^{-1}$, $q\beta q^{-1}$, $q\gamma q^{-1}$.

II. Solution by WILLIAM HOOVER, A. M., Ph. D., Professor of Mathematics and Astronomy, Ohio University, Athens, Ohio.

Angular velocities are resolved and compounded as are linear velocities. If ω_1, ω_2, ω_3 be the angular velocities designated in the problem, the resultant angular velocity is $\sqrt{\omega_1^2+\omega_2^2+\omega_3^2}=\omega$.

The direction cosines are $\frac{\omega_1}{\omega}$, $\frac{\omega_2}{\omega}$, $\frac{\omega_3}{\omega}$, determining the required positions.

PROBLEMS.

8. Proposed by H. C. WHITAKER, B. S,. M. E., Professor of Mathematics, Manual Training School, Philadelphia, Pennsylvania.

Find a general expression for the (integral) co-ordinates of a triangle with sides of integral lengths.